DRINKING WATER SURVEY OF SELECTED MUNICIPALITIES IN THE NIAGARA AREA AND LAKE ONTARIO

November, 1984

Ontario
Ministry of the Environment
Hon. Morley Kells
Minister
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SURVEY OF NIAGARA AREA
& SELECTED LAKE ONTARIO
MUNICIPAL DRINKING WATER SUPPLIES

November, 1984

ONTARIO MINISTRY OF ENVIRONMENT

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1. INTRODUCTION

The overall objective of the ambient river monitoring component of the Niagara River Toxics Committee (NRTC) project was to "assess the extent of toxic contamination in the Niagara River and locate areas in the River where significant inputs of toxic chemicals are occurring".

The recommendations contained in the NRTC report highlight the importance of maintaining a comprehensive monitoring and assessment program for Niagara area drinking water supplies.

To provide some immediate and current information in addition to routine monitoring on the quality of the treated water supplies in the Niagara area, a sampling was carried out in late October, 1984, on four water treatment plants in the Niagara area. The plants sampled were Niagara Falls, Fort Erie, Welland and St. Catharines. The St. Catharines Plant is also the source of Niagara-on-the-Lake and Thorold water supplies. A repeat sampling was carried out in the second week of November 1984, and three additional drinking water plants, Toronto (R.L. Clark), Hamilton and Oshawa were also sampled.

The NRTC report identified 139 chemicals of concern as being present in the ambient water environment*. This survey provides data for all of these chemicals (Table I). In addition, 15 general chemistry parameters (Tables IIA & IIB) were monitored as indicators of general water quality.

The analytical results are contained in this report along with relevant information on existing drinking water guidelines.

2. SUMMARY

Treated drinking water from seven water treatment plants (Niagara Falls, Fort Erie, Welland, St. Catharines, Metro Toronto (R.L. Clark), Hamilton and Oshawa) were tested for the chemicals of concern cited as being present in the Niagara River surface water environment by the Niagara River Toxics Committee report.

The analysis of these water supplies revealed that the drinking water meets all Ontario Drinking Water Objectives (ODWO) health-related criteria for those compounds referenced in the NRTC report. The data also indicate that the drinking water quality meets World Health Organization drinking water criteria for these compounds.

The results obtained in this survey are consistent with historical data for these plants.

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* (Chapter 6, pp. 6-3, Appendix D, pp D5-D11)

3. DISCUSSION

This survey was carried out to provide the most current information on the quality of drinking water supplies in light of the NRTC report findings.

The parameters tested for included the chemicals of concern flagged in the NRTC report, as well as general chemistry parameters.

The levels of trace metals and inorganic ions in Table I were consistent with those found in treated water supplies in Southern Ontario. The values for these reported in Table I were all at least ten times lower than the ODWO.

The number of non-detected values for the large range of trace organic compounds (Table I) is consistent with historic data bases for these water supplies.

With the exception of Alpha-BHC, no chlorinated pesticides or PCB were found to be present. This is consistent with historic data bases for these compounds.

The Alpha-BHC concentration was in the range of 0.003 to 0.006 parts per billion (ppb). There is no ODWO for Alpha-BHC, but there is an objective for Lindane, which is 99.9% Gamma-BHC, a compound similar to Alpha-BHC. The ODWO for Lindane is 4 ppb, a thousand-fold higher than that found to be present for Alpha-BHC in this survey. Alpha-BHC is a natural breakdown product of Gamma-BHC and is found at trace levels in raw waters throughout the Great Lakes.

Three chlorinated organics (trihalomethanes), which are formed during the drinking water treatment process, have been identified and quantified. The levels found were well below the ODWO for trihalomethanes and were consistent with historic data for plants on the Great Lakes.

There were only five other organic compounds found at levels above the detection limit. 1,3,5-trichlorobenzene was found at the detection limit at one location, 1,2,4,5-tetrachlorobenzene and 2,4,5-trichlorotoluene were detected at two locations, and hexane and bis(2-ethylhexyl) phthalate were found at the detection limit at 3 locations. ODWOs do not presently exist for these compounds.

However, for the general group of chlorinated aromatics (the chlorinated benzenes and the chlorinated toluene), an ambient water quality criterion has been proposed by the USEPA for one of them, which is considerably higher than the levels detected in this survey. The ambient water quality criterion for 1,2,4,5-tetrachlorobenzene is about 5000 times higher than the amount of this compound detected. The US ambient criterion is based on an acceptable daily combined intake for humans of drinking water and aquatic organisms from the same body of water.

Regarding hexane, the IJC Committee on the Assessment of Human Health Effects of Great Lakes Water Quality identified hexane as a compound of minimal concern in drinking water from a human health perspective, based on available data on toxicity, use, and environmental levels.

For bis (2-ethylhexyl) phthalate, the USEPA has also suggested an ambient water quality criterion of 15000 ppb, and the National Academy of Sciences have suggested a no adverse effect level of 4200 ppb for drinking water. Either of these limits is several thousand times higher than the levels found in the survey.

The levels for the general water chemistry parameters (Table IIA and IIB) were consistent with those found in Southern Ontario treated water supplies.

Data gained from this study will be fed into the pilot project at the Niagara Falls plant, as background information for the study of the effectiveness of conventional and granular activated carbon treatment on the removal of the chemicals identified here.

4. METHODS

4.1 Sampling

Sampling of treated water was conducted at Welland, St. Catharines, Fort Erie, Niagara Falls, Toronto (R.L. Clark), Hamilton and Oshawa Water Treatment Plants.

All sampling systems used met the following criteria:

a) Water was drawn from locations after completion of all physical and/or chemical treatment.

b) Sampling system piping and pumping material in contact with the sample water was organically inert (no plastics except teflon).

c) Sample tap outlets were located in a clean area of the plant which allowed adequate clearance under the tap and constant flow to waste.

4.2 Analytical

4.2.1 Organics

Water samples were extracted using methylene chloride as the extraction solvent. Following evaporation to a small volume, the sample extract was either (i) directly analysed by Gas Chromatography - Mass Spectrometry (GC/MS) for extractable basic, neutral or acidic organics or (ii) further treated by

chromatographic fractionation on florisil for organochlorine pesticides and PCB. Volatiles were analyzed using a purge and trap technique with Gas Chromatography and confirmation by Mass Spectrometry.

Basic, neutral and acidic organic analyses were carried out by GC/MS; all other sample extracts were analyzed using dual capillary Gas Chromatographic techniques. Quantification by Gas Chromatography was performed by comparison to an external standard. GC/MS quantification was conducted using an internal standard.

4.2.2 Metals, Inorganic Anion & General Chemistry

General water quality parameters, metals, and inorganic anions were determined according to the MOE Handbook of Analytical Methods for Environmental Samples, Volumes 1 and 2.

5. RESULTS AND INTERPRETATION

5.1 Data Tabulation

The data for the analysis of treated drinking water for the water treatment plants are listed in Tables I, IIA and IIB. Also included in these tables are the Maximum Acceptable Concentrations (MAC) for those compounds included in the ODWO.

Tables IIA and IIB list all parameters considered as "general chemistry". These are used to evaluate consistency and efficiency of water treatment plant operation.

5.2 Data Validation Criteria

The quality of the data presented in this report is based on the use of approved field and laboratory procedures, supported by appropriate quality control and quality assurance activities:

- Samples were taken by trained personnel according to Ministry of Environment (MOE) protocols established for low-level testing of organics, metals, and routine water quality parameters.

- In this project, field blanks and duplicate field samples were taken. Results from duplicate sample analysis agreed with expected variance levels. Field blanks indicated that adventitious contamination was negligible in the sampling procedures. Phthalates were found to be a bottle-related contaminant in the early stages of this survey and steps were taken to correct this problem.

- Proper containers were selected and pre-cleaned as required.

- Samples were transported to the laboratory in protected boxes as necessary. All required documentation was included on standard sample submission forms.

5.3 Detection Limits

Detection limits for all compounds are listed in Tables I, IIA and IIB. For those compounds for which no standard for GC/MS was available, the following assumptions were made:

- The recovery of the compound in the concentration process is identical to that of the internal standard.

- The Gas Chromatographic behaviour of the compound is identical to that of the internal standard.

- The Mass Spectrometric response of the compound is identical to that of the internal standard.

The data for those compounds for which no standards were available should be considered semi-quantitative at a detection level of 1.0 to 0.1 ppb depending on the Mass Spectrometric characteristics of individual compounds.

5.3.1 Organics-Gas Chromatographic Techniques

Detection limits using Gas Chromatography for most chlorinated pesticides, PCB, phenoxy acids and chlorophenols ranged from .001 to 0.10 ppb. For other organics such as the volatiles, the detection limit was 1 ppb.

5.3.2 Inorganics & Metals

The compounds reported are routinely determined in the laboratory. Detection limits are estimated from the long term standard deviation of low level real sample duplicates. These range from 0.1 ppb to 500 ppb.

6. CONCLUSIONS

(1) The data indicate that drinking water from these water supplies meets all health-related ODWO, for those compounds referenced in the NRTC Report.

(2) Of the organic compounds analysed for in the survey, only nine were found above detection limits.

(3) Three of the organic compounds detected, chlorodibromomethane, chloroform and dichlorobromomethane, were found at all four locations. These compounds are trihalomethanes and are generated in the treated water during the process of disinfection with chlorine. The MAC for total trihalomethanes was not exceeded.

(4) Alpha-BHC, 1,2,4,5-tetrachlorobenzene and 2,4,5-trichlorotoluene were found in the parts per trillion range, the former at all seven locations and the latter two only at Fort Erie and Niagara Falls. Hexane was detected at Welland, Toronto, and Oshawa. 1,3,5-trichlorobenzene was found at Niagara Falls at the detection limit, and bis(2-ethylhexyl) phthalate was found at the detection limit at Welland, Niagara Falls, and Oshawa.

(5) For inorganic parameters with an ODWO, only 6 were found above detection limits, but at levels less than 10% of the Objective. None of the toxic metals was detected.

(6) One of the 6 metals, aluminum, was present at levels higher than its Tolerance Limit* of 100 ppb. The levels found were within the range naturally present in raw Great Lakes water, and may be influenced by the addition of aluminum (alum) during the drinking water treatment process. The Tolerance Limit is set at 100 ppb for the protection of fish and depends on local conditions such as pH and alkalinity.

(7) The other metals (barium, chromium, copper, nickel, and zinc) were found at levels slightly above their respective detection limit, but well below their ODWO.

(8) Data produced from this survey are consistent with available historic data bases.

(9) The data from this survey indicate that a very high quality drinking water is provided to the seven municipalities sampled.

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* (Provincial Water Quality Objective) in Water Management, Ontario Ministry of the Environment, Toronto, 1984.

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TABLE I

ANALYSIS OF NIAGARA AREA WATER TREATMENT PLANTS

(all data in ug/l (ppb))

	Compound Name	Water Treatment Plants Sampled: Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
1	Aluminum	140/110	180/110	180/106	200/130	88	92	110	2	
2	Anthracene	nd	nd	nd	nd	nd	nd	nd	1	
3	Antimony	nd	nd	nd	nd	nd	nd	nd	1	
4	Arsenic	nd	nd	nd	nd	nd	nd	nd	1	50
5	Barium	12/11	12/11	12/10	12/11	11	12	12	2	1000
6	Benzaldehyde	nd	nd	nd	nd	nd	nd	nd	1	
7	Benzo(a)anthracene	nd	nd	nd	nd	nd	nd	nd	1	
8	Benzene	nd	nd	nd	nd	nd	nd	nd	0.1	10[h]
9	Benzenesulfonamide	nd	nd	nd	nd	nd	nd	nd	1	
10	Benzo(b))fluoranthene	nd	nd	nd	nd	nd	nd	nd	1	
11	Benzo(k)fluoranthene	nd	nd	nd	nd	nd	nd	nd	1	
12	Benzo(g,h,i)perylene	nd	nd	nd	nd	nd	nd	nd	1	
13	Benzo(a)pyrene	nd	nd	nd	nd	nd	nd	nd	1	0.01[h]
14	Beryllium	nd	nd	nd	nd	nd	nd	nd	1	
15	BHC (Alpha)	0.004/ 0.003	0.004/ 0.003	0.005/ 0.004	0.005/ 0.003	0.006	0.005	0.004	0.001	
16	BHC (Beta)	nd	nd	nd	nd	nd	nd	nd	0.001	
17	BHC (Gamma) Lindane	nd	nd	nd	nd	nd	nd	nd	0.001	4
18	Bis(2-ethylhexyl)phthalate	*/1	*/nd	*/1	*/nd	nd	nd	1	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
19	Bromoform	nd	nd	nd	nd	nd	nd	nd	1	350[c]
20	Butanal	nd	nd	nd	nd	nd	nd	nd	1	
21	Butanol	nd	nd	nd	nd	nd	nd	nd	1	
22	t-Butylphenols	nd	nd	nd	nd	nd	nd	nd	1	
23	Cadmium	nd	nd	nd	nd	nd	nd	nd	0.2	5
24	Carbon tetrachloride	nd	nd	nd	nd	nd	nd	nd	0.1	3[h]
25	Chlordane	nd	nd	nd	nd	nd	nd	nd	0.001	7
26	Chloroanthracenes	nd	nd	nd	nd	nd	nd	nd	1	
27	Chlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.1	
28	Chlorodibromoethanes	nd	nd	nd	nd	nd	nd	nd	1	
29	Chlorodibromomethane	5/6	6/6	5/5	6/6	6	7	6	0.1	350[c]
30	Chloro(difluorochloromethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
31	Chloroform	12/16	13/12	10/13	14/14	9	11	10	0.1	350[c]
32	Chlorohydroxybenzophenone	nd	nd	nd	nd	nd	nd	nd	1	
33	Chlorohydroxyphenothiazines	nd	nd	nd	nd	nd	nd	nd	1	
34	Chloromethylbis-(phenylmethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
35	Chloromethyldiphenylmethane	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
36	Chloromethoxybenzophenone	nd	nd	nd	nd	nd	nd	nd	1	
37	Chloronaphthalenes	nd	nd	nd	nd	nd	nd	nd	1	
38	Chlorotoluenes	nd	nd	nd	nd	nd	nd	nd	1	
39	3-Chloro(trifluoromethyl)benzene	nd	nd	nd	nd	nd	nd	nd	0.1	
40	Chromium	2/2	2/3	2/2	2/2	3	3	2	2	50
41	Chrysene	nd	nd	nd	nd	nd	nd	nd	1	
42	Copper	4/5	2/3	3/4	4/4	8	3	4	1	1000[f]
43	Cyanide	nd	nd	nd	nd	nd	nd	nd	1	200
44	2,4-D	nd	nd	nd	nd	nd	nd	nd	0.1	100
45	p,p'-DDD	nd	nd	nd	nd	nd	nd	nd	0.005	
46	p,p'-DDE	nd	nd	nd	nd	nd	nd	nd	0.001	
47	o,p'-DDT	nd	nd	nd	nd	nd	nd	nd	0.005	30[d]
48	p,p'-DDT	nd	nd	nd	nd	nd	nd	nd	0.005	30[d]
49	Dibenzo(a,h)anthracene	nd	nd	nd	nd	nd	nd	nd	1	
50	Dibromomethane	nd	nd	nd	nd	nd	nd	nd	1	
51	Dichloroanthracenes	nd	nd	nd	nd	nd	nd	nd	1	
52	1,2-Dichlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.1	
53	1,3-Dichlorobenzene	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
54	1,4-Dichlorobenzene	nd	nd	nd	nd	nd	nd	nd	1	
55	Dichlorobromoethane	nd	nd	nd	nd	nd	nd	nd	0.2	
56	Dichlorobromomethane	5/5	5/4	4/5	5/5	4	5	5	0.1	350[c]
57	1,2-Dichloroethane	nd	nd	nd	nd	nd	nd	nd	0.1	10[h]
58	Dichloromethylbis-(phenylmethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
59	Dichloromethyldiphenylmethane	nd	nd	nd	nd	nd	nd	nd	1	
60	Dichloronaphthalenes	nd	nd	nd	nd	nd	nd	nd	1	
61	Di-n-butyl phthalate	*/nd	*/nd	*/nd	*/nd	nd	nd	nd	1	
62	Dichlorophenols	nd	nd	nd	nd	nd	nd	nd	1	
63	1,2-Dichloropropane	nd	nd	nd	nd	nd	nd	nd	0.1	
64	2,6-Dichlorotoluene	nd	nd	nd	nd	nd	nd	nd	1	
65	Dichlorotoluenes	nd	nd	nd	nd	nd	nd	nd	1	
66	Dichloropropenes	nd	nd	nd	nd	nd	nd	nd	1	
67	Dichloro(trifluoromethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
68	2,4-Dichloro-2-phenoxyethanol	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Compound Name		Water Treatment Plants Sampled (all data in ug/l (ppb))								
		Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
69	Dichloro(trifluoromethyl)-benzophenone	nd	nd	nd	nd	nd	nd	nd	1	
70	Dieldrin	nd	nd	nd	nd	nd	nd	nd	0.004	0.7[a]
71	Diethylbenzenes	nd	nd	nd	nd	nd	nd	nd	1	
72	Diethyldisulphide	nd	nd	nd	nd	nd	nd	nd	1	
73	Dimethylaniline	nd	nd	nd	nd	nd	nd	nd	1	
74	Dimethyldisulphide	nd	nd	nd	nd	nd	nd	nd	1	
75	N,N-Dimethyl-2-propenamide	nd	nd	nd	nd	nd	nd	nd	1	
76	Diphenyldifluoromethane	nd	nd	nd	nd	nd	nd	nd	1	
77	Dioctyl phthalate	*/nd	*/nd	*/nd	*/nd	nd	nd	nd	1	
78	Endosulfan I	nd	nd	nd	nd	nd	nd	nd	0.002	
79	Endosulfan II	nd	nd	nd	nd	nd	nd	nd	0.004	
80	Endrin	nd	nd	nd	nd	nd	nd	nd	0.004	0.2
81	Ethylbenzene	nd	nd	nd	nd	nd	nd	nd	0.1	
82	Ethyltoluenes	nd	nd	nd	nd	nd	nd	nd	1	
83	Fluoranthene	nd	nd	nd	nd	nd	nd	nd	1	
84	Fluorene	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
85	Furan	nd	nd	nd	nd	nd	nd	nd	1	
86	Heptachlor epoxide	nd	nd	nd	nd	nd	nd	nd	0.001	3[b]
87	Hexachlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.001	0.01[h]
88	Hexachlorobutadiene	nd	nd	nd	nd	nd	nd	nd	0.001	
89	Hexachlorotoluene	nd	nd	nd	nd	nd	nd	nd	1	
90	Hexanal	nd	nd	nd	nd	nd	nd	nd	0.1	
91	Hexane	nd/0.1	nd	nd	nd	0.1	nd	0.1	0.1	
92	Hexenones	nd	nd	nd	nd	nd	nd	nd	1	
93	Isobutanal	nd	nd	nd	nd	nd	nd	nd	1	
94	Isobutanol	nd	nd	nd	nd	nd	nd	nd	1	
95	Lead	nd	nd	nd	nd	nd	nd	nd	3	50
96	Mercury	nd	nd	nd	nd	nd	nd	nd	0.02	10
97	Methylene chloride (Dichloromethane)	nd	nd	nd	nd	nd	nd	nd	5	
98	Methylfuran	nd	nd	nd	nd	nd	nd	nd	1	
99	Methylnaphthalenes	nd	nd	nd	nd	nd	nd	nd	1	
100	Methylpentenes	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
101	Mirex	nd	nd	nd	nd	nd	nd	nd	0.005	
102	Nickel	nd	2/2	nd	nd	2	nd	nd	2	
103	Polychlorinated biphenyls (PCB)	nd	nd	nd	nd	nd	nd	nd	0.02	3[g]
104	Pentachloranisole	nd	nd	nd	nd	nd	nd	nd	1	
105	Pentachlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.001	
106	Pentachloromethylbis-(phenylmethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
107	Pentachlorophenol	nd	nd	nd	nd	nd	nd	nd	1	10[h]
108	Pentachlorotoluene	nd	nd	nd	nd	nd	nd	nd	1	
109	Phenanthrene	nd	nd	nd	nd	nd	nd	nd	1	
110	Phenol	nd	nd	nd	nd	nd	nd	nd	1	2[f]
111	Phenothiazine	nd	nd	nd	nd	nd	nd	nd	1	
112	Pyrene	nd	nd	nd	nd	nd	nd	nd	1	
113	Selenium	nd	nd	nd	nd	nd	nd	nd	1	10
114	Silver	nd	nd	nd	nd	nd	nd	nd	0.1	50
115	Silvex (2,4,5-TP)	nd	nd	nd	nd	nd	nd	nd	0.05	10
116	Styrene	nd	nd	nd	nd	nd	nd	nd	0.1	
117	2,4,5-T	nd	nd	nd	nd	nd	nd	nd	0.05	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
118	TCDD **	nd	nd	nd	nd	nd	nd	nd	0.00001	
119	1,2,3,4-Tetrachlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.001	
120	1,2,4,5-Tetrachlorobenzene	nd	nd	0.009/nd	0.004/nd	nd	nd	nd	0.001	
121	1,1,2,2-Tetrachloroethane	nd	nd	nd	nd	nd	nd	nd	0.1	10[h]
122	Tetrachloroethene	nd	nd	nd	nd	nd	nd	nd	0.1	10[h]
123	Tetrachloromethylbis-(phenylmethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
124	Tetrachlorotoluenes	nd	nd	nd	nd	nd	nd	nd	1	
125	Tetrahydrofuran	nd	nd	nd	nd	nd	nd	nd	1	
126	(Tetramethylbutyl)phenols	nd	nd	nd	nd	nd	nd	nd	1	
127	Trichloroanthracenes	nd	nd	nd	nd	nd	nd	nd	1	
128	1,2,4-Trichlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.005	
129	1,2,3-Trichlorobenzene	nd	nd	nd	nd	nd	nd	nd	0.005	
130	1,3,5-Trichlorobenzene	nd	nd	nd/0.005	nd	nd	nd	nd	0.005	
131	Trichlorodiphenylmethane	nd	nd	nd	nd	nd	nd	nd	1	
132	1,1,1-Trichloroethane	nd	nd	nd	nd	nd	nd	nd	0.1	
133	Trichloroethene	nd	nd	nd	nd	nd	nd	nd	0.1	30[h]
134	Trichloromethylbis-(phenylmethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	

TABLE I - continued

Water Treatment Plants Sampled

(all data in ug/l (ppb))

	Compound Name	Welland I/II[2]	St. Catharines I/II[2]	Niagara Falls I/II[2]	Fort Erie I/II[2]	Toronto (R.L. Clark) II[3]	Hamilton II[3]	Oshawa II[3]	Detection Limits	Drinking Water Objectives[1]
135	Trichlorophenols	nd	nd	nd	nd	nd	nd	nd	0.05[e]	10[h]
136	2,4,5-Trichlorotoluene	nd	nd	0.013/nd	0.012/0.014	nd	nd	nd	0.005	
137	(Trifluoromethyl)benzene	nd	nd	nd	nd	nd	nd	nd	1	
138	Trimethylbenzenes	nd	nd	nd	nd	nd	nd	nd	1	
139	Zinc	2/1	2/1	2/2	3/2	2	1	1	1	5000[f]

TABLE I - continued

Table I Footnotes

1 ODWO = Ontario Drinking Water Objectives unless otherwise noted

2 I/II = Week of October 29 survey/Week of November 12 survey

3 II = Week of November 12 survey

[a]ODWO for dieldrin + aldrin is 0.7 ug/l

[b]ODWO for heptachlor + heptachlor epoxide is 3 ug/l

[c]ODWO for trihalomethanes for all four (chloroform, bromodichloromethane, chlorodibromomethane and bromoform) should not exceed 350 ug/l

[d]ODWO for all DDT isomers in total should not exceed 30 ppb.

[e]detection for trichlorophenols

2,4,5-trichlorophenol	0.05 ppb
2,4,6-trichlorophenol	0.05 ppb
2,3,4-trichlorophenol	0.1 ppb

[f]limit related to aesthetic considerations only (MDC)

[g]interim maximum acceptable concentration

[h]World Health Organization Guidelines for Drinking Water Quality

* No data - sample contamination

** most recent analysis for total TCDD is 1983: nd at detection of 10 parts per quadrillion (ppq)

µg/l = ppb

nd = none detected at detection limit specified for particular parameter

na = not analysed

Table I Footnotes

Ontario Drinking Water Objectives (ODWO)

The primary purpose of drinking water objectives is the protection of the health of the public consuming the water. Aesthetic considerations may also provide a basis for drinking water objectives, since the water should be pleasant to drink. The control of such aspects of water quality as hardness, corrosiveness, etc is also important. The limits set are considered to outline the minimum requirements necessary to fulfill the above objectives, and may be either health related or related to aesthetic and other considerations. The following three types of limits are recognized: -

Maximum Acceptable Concentration (MAC) - is used for limits applied to substances, above which there are known or suspected adverse health effects.

Interim Maximum Acceptable Concentration (IMAC) - is used for limits for substances of current concern with known chronic effects in mammals and for which there are no established MAC's.

Maximum Desirable Concentration (MDC) is used for limits applied to substances which, when present at concentrations above the limits are either aesthetically objectionable or may interfere with good water quality control practices.

TABLE II - A

ANALYSIS OF TREATED WATER FOR GENERAL WATER QUALITY PARAMETERS *

(Survey Week of October 29, 1984)

Compound/ Parameter	Welland	St. Catharines	Niagara Falls	Fort Erie	Units	Detection Limits	ODWO
1 Alkalinity	90.2	94.9	91.7	93.9	mg/l as $CaCO_3$	0.78	
2 Calcium	36.3	37.3	35.3	36.1	mg/l	0.25	
3 Chloride	16.5	16.7	15.8	16.3	mg/l	0.81	
4 Colour	<1.0	< 1.5	1.0	1.2	True Color Units	1.0	
5 Conductivity	296	299	290	291	µ mho/cm at 25°C	1.3	
6 Fluoride	0.78	0.12	0.11	0.12	mg/l	0.011	2.4
7 Hardness	126	128	122	124	mg/l as $CaCO_3$	1.2	
8 Nitrate	0.25	0.20	0.20	0.20	mg/l as N	0.12	10.0
9 Nitrite	nd	nd	nd	nd	mg/l as N	0.0013	1.0
10 pH	7.8	7.9	7.9	7.9	pH units	-	
11 Total Solids	193	194	189	190	mg/l	8.6	
12 Turbidity	0.23	0.26	0.21	0.47	FTU	0.20	1
13 Sodium	8.3	8.5	8.3	8.3	mg/l	0.25	
14 Magnesium	8.50	8.50	8.20	8.35	mg/l	0.15	
15 Reactive Phenolics	nd	nd	nd	nd	ug/l	0.59	

* Average of duplicate samples except for pH

TABLE II - B

ANALYSIS OF TREATED WATER FOR GENERAL WATER QUALITY PARAMETERS *

(Survey Week of November 12, 1984)

Compound/ Parameter	Welland	St. Catharines	Niagara Falls	Fort Erie	Toronto (R.L. Clark)	Hamilton	Oshawa	Units	Detection Limits	ODWO
1 Alkalinity	93.3	96.4	93.1	95.6	84.1	87.2	88.6	mg/l as $CaCO_3$	0.78	
2 Calcium	35.0	35.0	32.5	34.7	36.6	36.8	36.3	mg/l	0.25	
3 Chloride	16.4	16.3	15.7	15.9	27.8	27.1	25.5	mg/l	0.81	
4 Colour	1.0	1.5	1.3	1.3	2.0	1.3	1.0	True Colour Units	1.0	
5 Conductivity	300	298	291	288	325	325	323	μ mho/cm at 25°C	1.3	
6 Fluoride	0.69	0.12	0.12	0.12	1.10	0.88	1.18	mg/l	0.011	2.4
7 Hardness	121	121	114	119	114	124	123	mg/l as $CaCO_3$	1.2	
8 Nitrate	0.30	0.25	0.20	0.30	0.40	0.40	0.40	mg/l as N	0.12	10.0
9 Nitrite	nd	nd	nd	nd	nd	nd	nd	mg/l as N	0.013	1.0
10 pH	7.7	7.8	7.9	7.8	7.4	7.6	7.8	pH Units	-	
11 Total Solids	195	194	190	188	211	211	210	mg/l	8.6	
12 Turbidity	0.13	0.38	0.23	0.23	0.18	0.28	0.19	FTU	0.20	1
13 Sodium	9.2	9.0	8.5	8.5	12.5	12.4	12.3	mg/l	0.25	
14 Magnesium	8.10	8.05	7.85	7.93	7.90	7.70	7.85	mg/l	0.15	
15 Reactive Phenolics	nd	nd	nd	nd	nd	nd	nd	ug/l	0.59	

* Average of duplicate samples except for pH

APPENDIX 1

1.1 Sampling

Sampling of treated water was conducted at Welland, St. Catharines, Fort Erie, Niagara Falls, Toronto (R.L. Clark), Oshawa and Hamilton water treatment plants.

All sampling systems used met the following criteria:

- Water was drawn from locations after completion of all physical and/or chemical treatment.
- Sampling system piping and pumping material in contact with the sample water was organically inert (no plastics except teflon).
- Sample tap outlets were located in a clean area of the plant which allowed adequate clearance under the tap and constant flow to waste.

Sampling bottles were specially treated for their intended use and consisted of the following:

6 - 1 litre brown glass, foil lined cap, for pesticides and organic analyses

2 - 1 litre brown glass, teflon lined cap, for chlorophenols and phenoxyacids

1 - 200 ml glass for phenol analysis

1 - 200 ml glass for mercury analysis

2 - 500 ml plastic widemouth for cyanide and metal analysis

1 - 1 litre glass for general chemistry analysis

The sampling procedure was as follows:

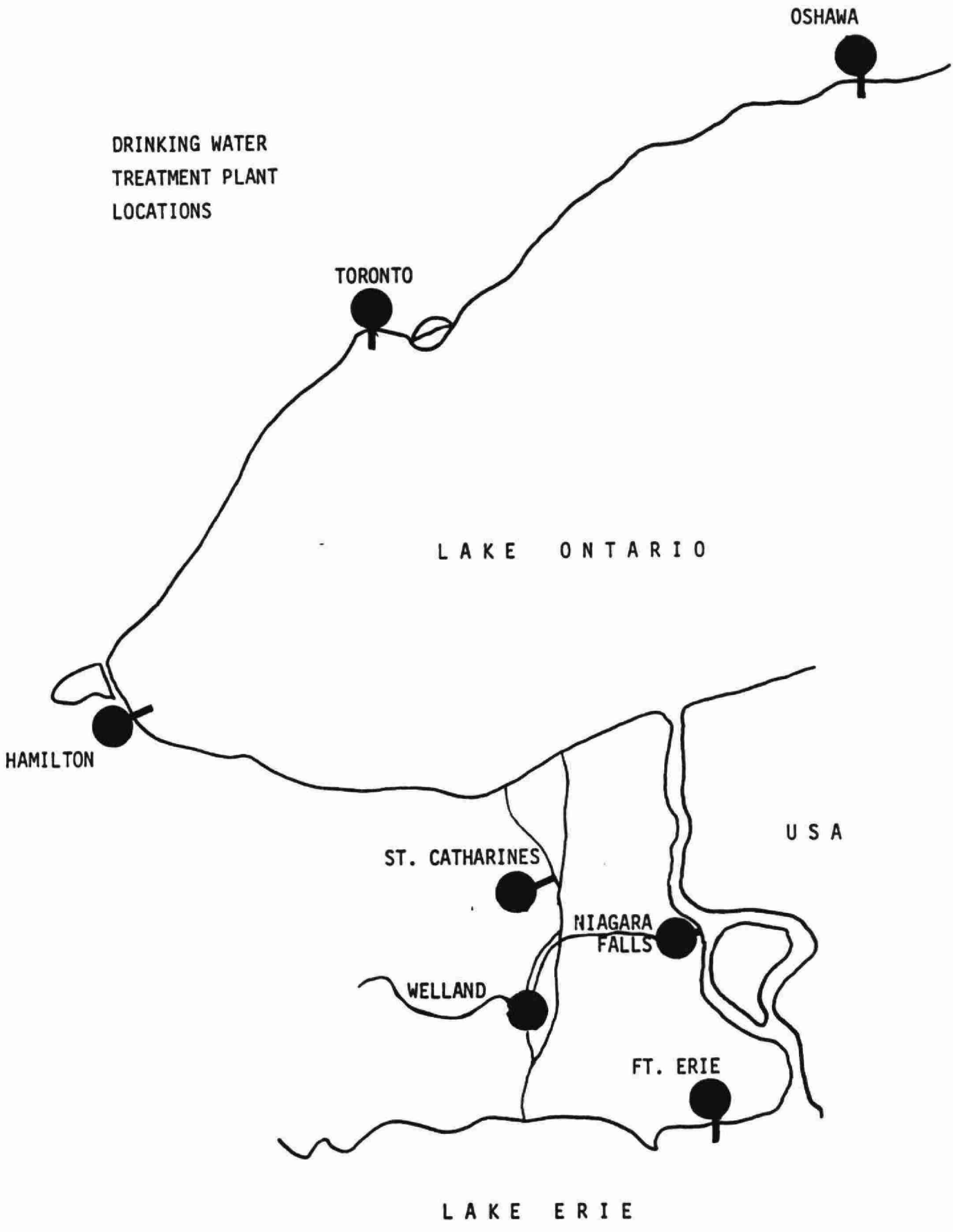
- All sample lines were flushed prior to sampling
- Bottles were not rinsed with sample prior to filling
- A one inch head-space was left at the top of each bottle
- No airspace was left for samples for volatile analysis
- Preservatives were added to the samples where required according to MOE protocols

Field blanks were submitted with each sample set from each plant.

Field personnel took all precautions while sampling to avoid contamination of the sample. No part of the tap touched the bottle during filling. The bottle cap was held face down to prevent possible contamination. Tap flow was not altered during the sampling interval. No smoking was allowed in the sampling area to avoid possible contamination by combustion by-products.

Support data taken at each plant consisted of a description of plant operations at the time of sampling such as flow rates, retention times, chemicals added, and plant turbidities.

Samples were transported to the laboratory within 12 hours of sampling.


OSHAWA
DRINKING WATER
TREATMENT PLANT
LOCATIONS
TORONTO
LAKE ONTARIO
HAMILTON
USA
ST. CATHARINES
NIAGARA
FALLS
WELLAND
FT. ERIE
LAKE ERIE